

# An easy and cheap way to use smartphones as a microscope

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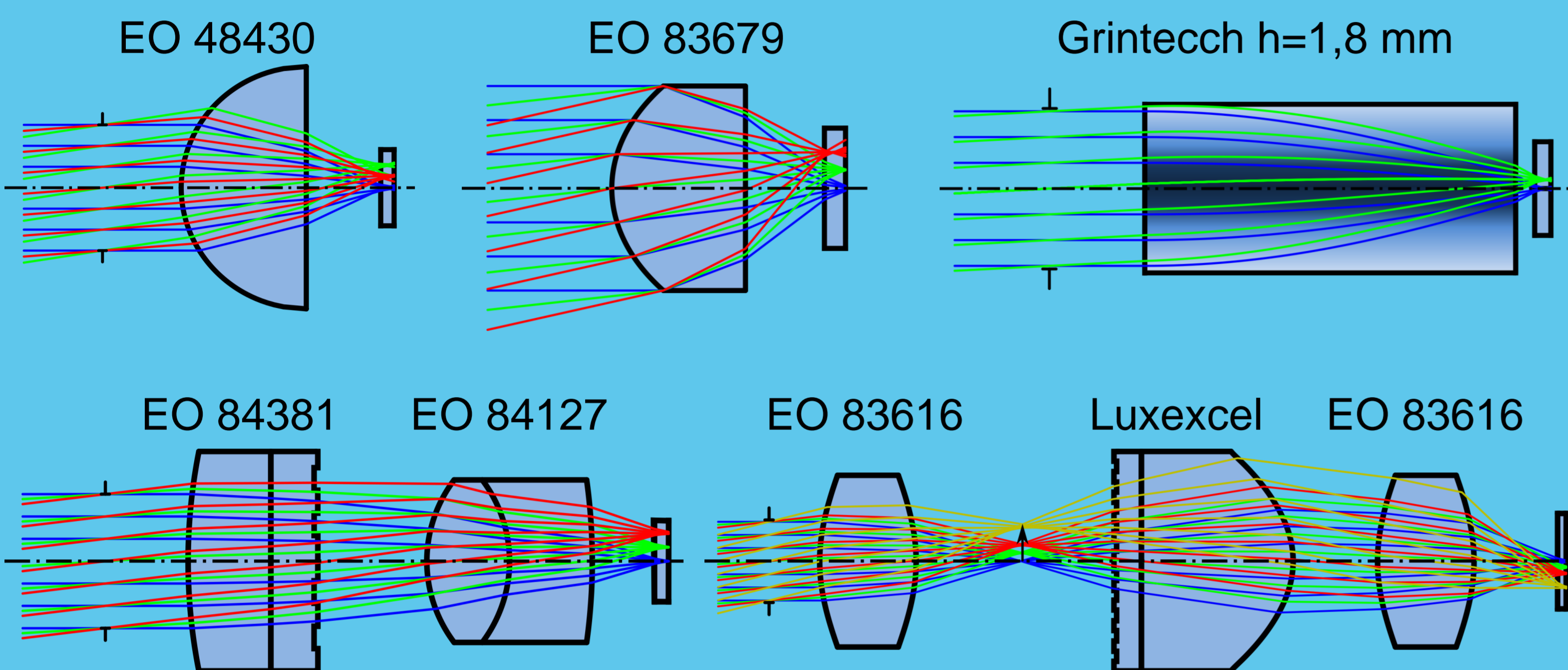
## Motivation

The evidence of widespread **diseases requires microscopic examination** and evaluation by health care professionals. **Smartphones are all around** in developing countries and can serve as microscopes to **improve global health care**.

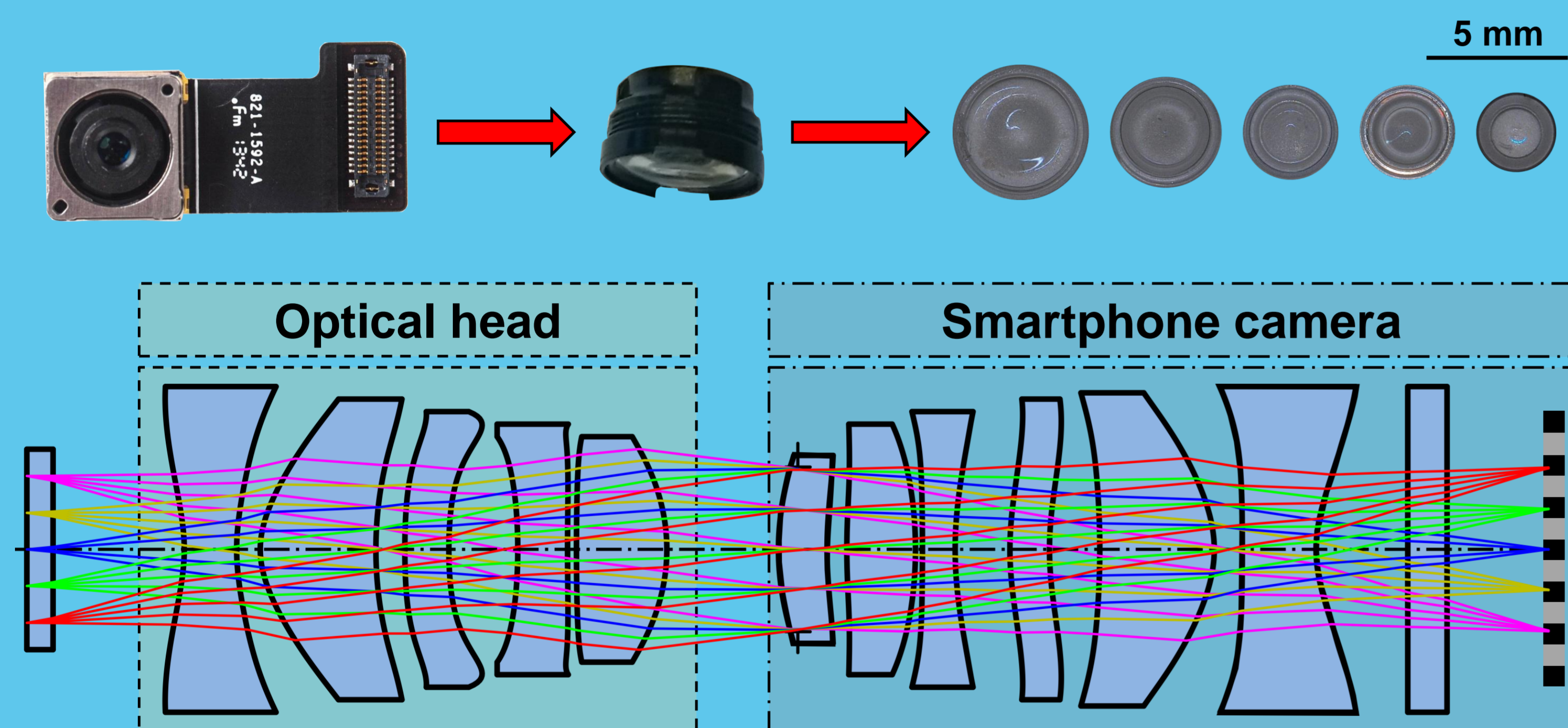
## Aim

Develop an **optical head** to use **smartphones as a microscope** for diagnostic purposes. The optical head should be **cheap, suitable for many smartphones**, resolve **structures of 5 microns**, and the **full image sensor** should be used.

## Investigated optical solutions



The **simplest and most cost effective** possibility is to use **smartphone camera modules** as an optical head like in reference [1]. We position them (reversed) in front of the smartphone camera and achieved a **resolution of 360 line pairs per mm**.

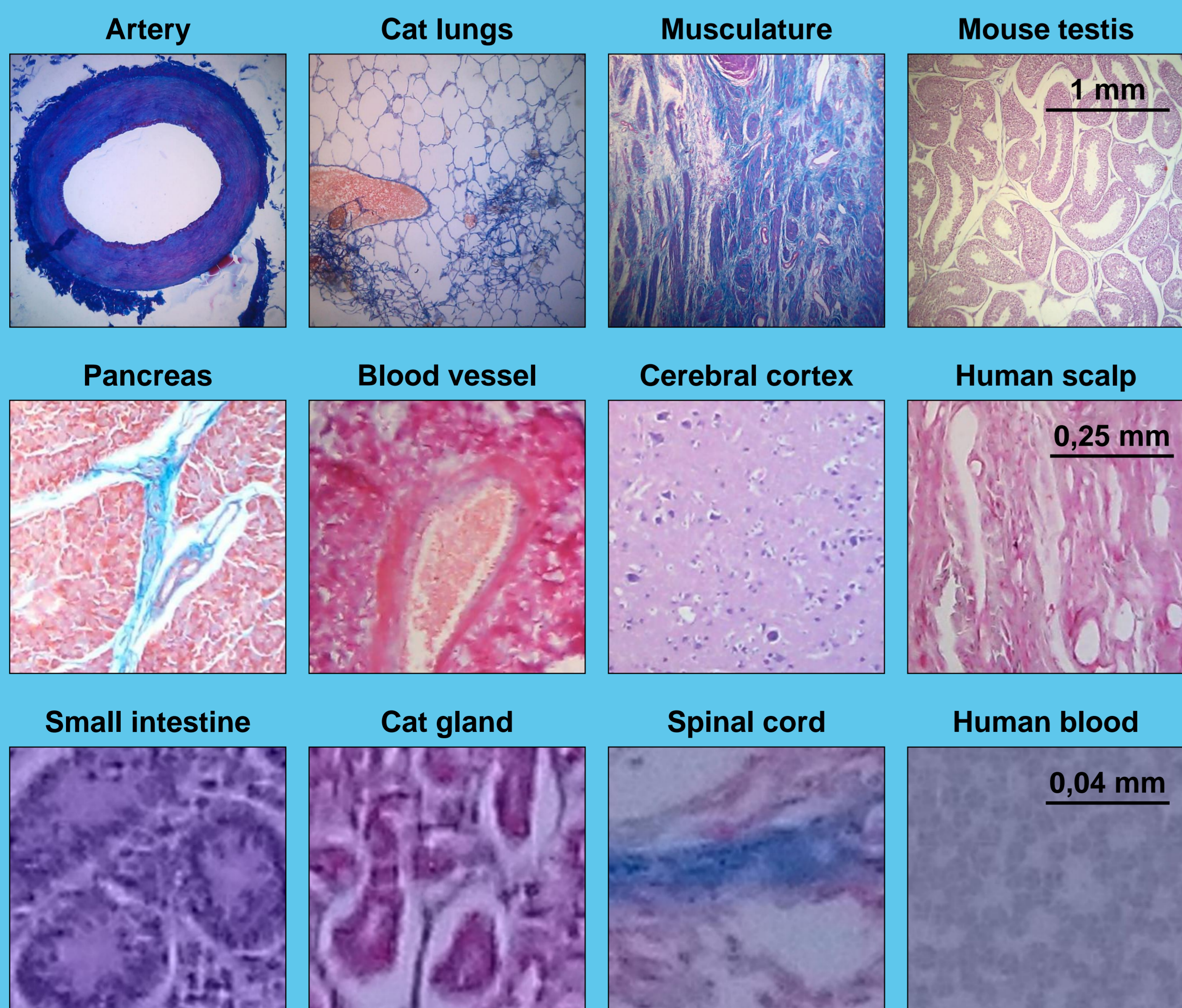


## 3D printed mechanics

We designed different objective holders for the smartphone camera modules. All of them are producible with a **3d-printer** and **suitable for many different smartphone** manufacturers. All of the 3D printed mechanics allow **mechanical focusing**.



## Recorded images



## Imaging of phase objects



We modified the optical head to create a smartphone **phase contrast microscope**. We also built a **holographic setup**. Both structures are inexpensive and allow imaging of **phase objects** with a smartphone.